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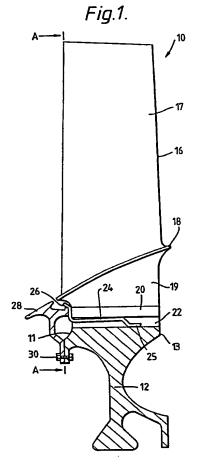
(56) Documents cited GB 2038959 A GB 2021206 A GB 1491480 A EP 0110744 A1 EP 0083289 A1 US 4478554 A US 4265595 A US 4208170 A

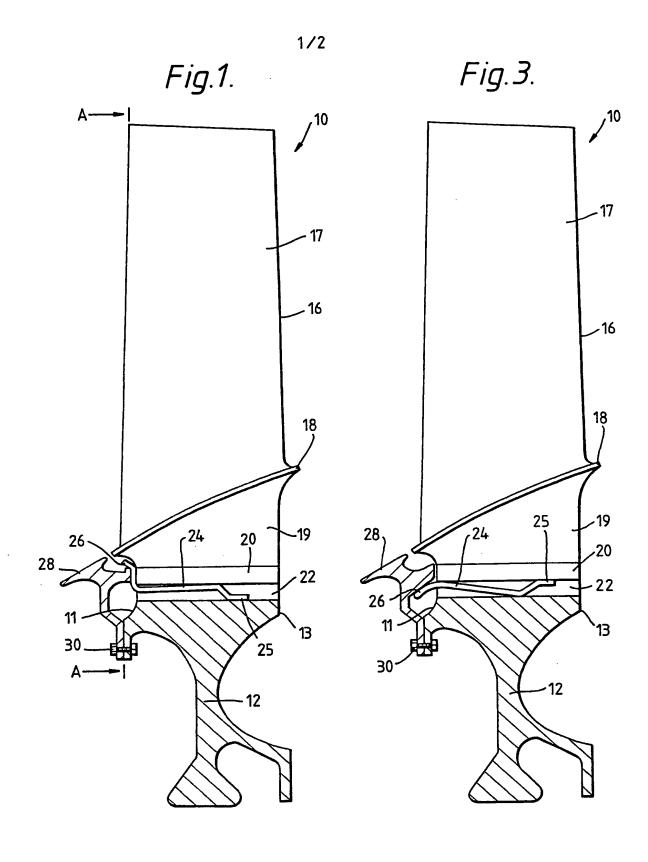
(58) Field of search UK CL (Edition K) F1V VCN INT CL⁵ F01D, F04D

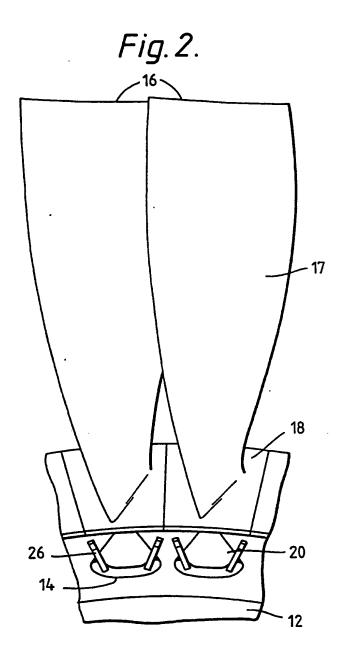
(54) Fan blade retainer

(57) A rotor 10 has radially extending fan blades 16 disposed circumferentially around a rotor disc 12. The blades 16 have roots 20 which are located in grooves 14 in the periphery of the rotor disc 12. An elongate member 24 is interposed between the bottom of the groove 14 and the blade root 20 and has one end 25 attached to the bottom of the groove.

The elongate member 24 has projections 26 which extend forward of an upstream face 11 of the rotor disc 12. A thrust ring 28 engages the projections 26 urging them radially outward. In an alternative arrangement (Figure 3) one end of the elongate member is attached to the blade root while projections at the other end are urged radially inward by a thrust ring. Movement of the projections 26 causes a radially outward load to be applied to the blade root 20 which inhibits radial movement of the blade root 20 in the groove 14.







BLADE RETAINER

The present invention relates to a device for retaining radially projecting blades on a rotor. In particular it relates to a device suitable for retaining fan blades on a rotor disc of a gas turbine engine such that radial movement of the blades relative to the rotor disc is prevented.

In a gas turbine engine a rotor, such as a fan rotor, has radially extending fan blades which are located in a plurality of grooves disposed circumferentially around a rotor disc. If the gas turbine engine is mounted on an aircraft and the engine is not operational wind passing through the fan rotates it. This is known as windmilling and as the fan rotates slowly the blades are able to move within the circumferential grooves as there is insufficient centrifugal force to push the fan blades radially outwards against the rotor disc. This movement can result in serious scoring and frettage of the blade root.

To avoid frettage of the blade roots it is known to insert biasing blocks between the bottom of the groove and the blade root. These biasing blocks are in the form of rubber wedges which exert a radially outward force on the blade root to hold the blade root firmly in contact with the rotor disc. Due to manufacturing tolerances the radial load exerted on the blade root by the rubber wedges can vary considerably. If the radial load is too great installation difficulties are experienced as the load must be overcome to install the wedge in the groove beneath the blade root. A further problem with the rubber wedges is that over a period of time the wedge which is under compression will deform plastically reducing the radial load and allowing some movement of the blade root in the groove which results in wear.

The present invention seeks to provide an improved retention device which biases the blades radially outward

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in the and does not necessitate the use of an elastomer material.
                                                                                                                                                                                                                                                                                                                           in the grooves of the rotor disc and does not necessitate the use of an elastomer material.

According to the present invention a retention device
                                                                                                                                                                                                                                                                                                                                                              According to the present invention a retention device
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                                                                                                                                                                                                             the upstream face of the projection which extends forward of engaging
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The blade root to inhibit radial
                                                                                                                                         Movement of the blade root in the groove.
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                                                                        there being provided a radial space and a downstream face of the aroove and the blade root into which
                                                               the retention device is inserted. the retention which
                                                       the retention the groove and the elade of the steention device is and the one end of which is
                                                Comprises an elongate member
                                    operationally elongate

Troove the other end having addally inward face of the other one end having an at least one of the other one of the ot
                         operationally attached to the which extends forward of the unstream face of the rotor
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         disc and means for engaging the upstream race of the state one
urging it radially outward so that the elongate member is
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brought into contact with the blade root to apply a radially outward load on the blade root and inhibit radial movement of the blade root in the groove. The at least one projection may be inclined radially outward.

In a further embodiment of the present invention a retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprises an elongate member which one end of operationally attached to the blade root the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially inward so that the elongate member is brought into contact with the bottom of the groove so that the one end of the elongate member attached to the blade root applies a radially outward load on the blade root to inhibit radial movement of the blade root in the groove. The at least one projection may be inclined radially inward.

Preferably the means for engaging the at least one projection is a thrust ring which is attached to the upstream face of the rotor disc.

Preferably a pair of projections are provided on the end of the elongate member which extend forward of the upstream face of the disc.

The elongate member may be manufactured from carbon composite or sheet metal.

The present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a partially cross-sectional view of a rotor having a radially projecting blade retained thereon in accordance with one embodiment of the present

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invention.

Figure 2 is a Pictorial View of retained thereon in accordance With the embodiment of the the
                                                                                            i_{n_{Ve_{n}}}t_{i_{On}}.
                                                                                  when viewed along line AA in figure 1, having the blue of
                                                                                present invention shown in figure 1.
                                                                                         Figure 3 is a partially cross-sectional view of there.
                                                                          totor having a radially projecting blade retained of the the
                                                                        In accordance with a further embodiment of the
                                                                       i_{n_{Vention}}.
                                                                               Antion.

Referring to

Tanerally figure 1 a rotor of a gas turbine 1 or rotates about an axis
                                                               engine, generally indicated a rotor of rotor 10 comprises a disc about an axis
                                                              engine, generally indicated at 10, rotates about an ax ranging his moninted tharange.
                                                          (not shown). The The disc 12 having a nlurality of arooves 14 finure 2 in
                                                        The disc 12 has a plurality of grooves 16 mounted thereon.

the circumference thereof in which the fan blades in blades in blades are
                                                     The disc 12 has

the circumference a plurality of grooves

fan blada 15 has an aerofoll electron 17
                                                  the circumference

MOUNTED. A fan blade thereof in

a shank 19 and a naerofoil section 17,

The hiade root 20. The hiade root 2
                                                Platform 18, a shank 19 and an aerofoll

corresponding to the oroove 14 in the rotor
                                                                                                                                                                                                             p_{resent}
                                             has a shape corresponding to the groove 14 in the rotor other
                                           has a shape

form and engages the disc 12 by sliding dovetail or other axially into
                                        form and blade root 20 may be of dovetail or o
                                        gr<sub>00ve</sub> 14.
                                                The grooves 14 extend across the periphery of the stream face 11 to a downetream face
                                disc 12 from an upstream across the front 20 is in sitn in the months and face 11 to a downstream face in the months of the mont
                              When the blade root 20 is face II to a downstream face 13.

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The blade root 20 is face II to a downstream face 13.

The blade root 20 there and the blade root 20 and
                           When the blade root 20 is in situ in the bottom of the blade root 20 is order to order to order to order to order root 20 and roots.
                         is a space 22 between the bottom of the blade root 20 and roove 14 an
                      the bottom of the elongate member 24 is inserted within the groove 14 an hence 22 hence the
                    elongate member 24 is inserted into the space 22 beneath
                   the blade root 20.
                            In one embodiment of the present invention, shown
            In one embodiment of the present invention, shown in the arcove I4 to maintain it in position.
         to the bottom of the groove 14 to member 24 is attached elongate member 24 is nrowided with a
      The tree end of the groove 14 to maintain it in position of the which extend provided with of the
    The free end of the elongate member 24 is provided with a the disc 12. The projections 26 the projections 26 the disc 12. The projections 26 the disc 26 are
  upstream face 11 of the disc 12.
tapered and are inclined radially outward.
         Pred and are inclined radially outward.

When elongate members 24 have been positioned beneath
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each of the blades 14 in the rotor 10 a thrust ring 28 is offered up to the upstream face 11 of the disc 12. The thrust ring 28 engages the projections 26 urging them radially outward. Movement of the projections 26 radially outward biases the elongate member 24 towards the blade root 20. The elongate member 24 comes into contact with the bottom of the blade root 20 and exerts a radially outward force thereon. The radially outward force exerted on the blade root 20 prevents the blade root 20 from moving radially in the groove 14.

In a further embodiment of the present invention, shown in figure 3, the end 25 of the elongate member 24 is attached to the bottom of the blade root 20 to maintain it in position. The free end of the elongate member 24 is provided with a pair of projections 26 which extend forward of the upstream face 11 of the disc 12. The projections 26 are tapered and are inclined radially inward.

When elongate members 24 have been positioned beneath each of the blades 14 in the rotor 10 a thrust ring 28 is offered up to the upstream face 11 of the disc 12. The thrust ring 28 engages the projections 26 urging them radially inward. Movement of the projections 26 radially inward biases the elongate member 24 towards the bottom of the groove 14. The elongate member 24 comes into contact with the bottom of the groove 14 and the end 25 of the elongate member 24 exerts a radially outward force on the blade root 20. The radially outward force exerted on the blade root 20 prevents the blade root 20 from moving radially in the groove 14.

In both of the embodiments described the thrust ring 28 engages with the projections 26 of the elongate members 24 under each of the blades 16 so that a radially outward force is exerted on all the blades 16 in the rotor 10. The radially outward force is not exerted on the blades 16 until the thrust ring 28 is mounted on the upstream face 11 of the disc. The thrust ring 28 is attached to the

upstream face 11 of the disc 12 by bolts 30. The thrust ring 28, once attached to the upstream face 11 of the disc 12, maintains the elongate member 24 in the biased position and prevents axial movement of the blades 16.

The elongate member 24 may be manufactured from either pressed out metal or carbon composite material.

Claims:

- A retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which is operationally attached to either the radially inward face of the groove or the blade root the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially outward when the one end of the elongate member is attached to the radially inward face of the groove or radially inward when the one end of the elongate member is attached to the blade root so that the elongate member applies a radially outward load on the blade root to inhibit radial movement of the blade root in the groove.
- A retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a one of a plurality of grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which is operationally attached to the radially inward face of the groove the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially outward so that the elongate member is brought into contact with the blade root to apply a radially outward load on the blade root and inhibit radial movement of the blade root in the groove.

- A retention device for applying a radially outward load on a blade mounted on a rotor disc, the blade having a root which is received in a on of a plurality grooves disposed circumferentially around the rotor disc, the rotor disc having an upstream face and a downstream face, there being provided a radial space between a radially inward face of the groove and the blade root into which the retention device is inserted, the retention device comprising an elongate member one end of which operationally attached to the blade root the other end having an at least one projection which extends forward of the upstream face of the rotor disc and means for engaging the at least one projection urging it radially inward so that the elongate member is brought into contact with the bottom of the groove so that the one end of the member attached to the blade root applies a outward load on the blade root to inhibit radial movement of the blade root in the groove.
- 4. A retention device as claimed in claim 2 in which the at least one projection is inclined radially outward.
- 5. A retention device as claimed in claim 3 in which the at least one projection is inclined radially inward.
- 6. A retention device as claimed in any preceding claim in which the means for engaging the at least one projection is a thrust ring which is attached to the upstream face of the rotor disc.
- 7. A retention device as claimed in any preceding claim in which a pair of projections are provided on the end of elongate member which extends forward of the upstream face of the disc.
- 8. A retention device as claimed in any preceding claim in which the elongate member is manufactured from carbon composite.
- 9. A retention device as claimed in any of claims 1-7 in which the elongate member is manufactured from pressed metal.

- 10. A retention device as hereinbefore described with reference to and as shown in figures 1 and 2.
- 11. A retention device as hereinbefore described with reference to and as shown in figure 3.

Examin r's report to the Comptroller under Section 17 (The Search Report)

Application number

9125820.2

		<u> </u>	9123020.2
Relevant Technical fi	elds		
(i) UK CI (Edition	к)	F1V (VCN)	Search Examiner
(ii) Int CL (Edition	- 1		C B VOSPER
(II) III OL (Laidoi)	5)	F01D, F04D	
Databases (see over)			
(i) UK Patent Office			Date of Search
(ii)			15 MAY 1992

Documents considered relevant following a search in respect of claims

1 TO 11

Category (see over)	Identity of document and	Relevant to claim(s)	
х	GB 2038959 A	(GENERAL) see Figure 1 and 4 and page 3 lines 20 et seq	1,3,5, and 7
х	GB 2021206 A	(GENERAL) see whole document but note figure 10 and page 4 lines 79 et seq, in particular	1,2 and 4
A	GB 1491480	(ROLLS) see Figure 3	1 and 2 at leas
x	EP 0110744 A1	(SOCIETE) see Figure 1 and note action of wedge 23 on member 13	1 and 3
A	EP 0083289 A1	(SOCIETE) see Figure 4	1 and 2 at 1 as
х	US 4478554	(S.N.E.C.M.A) see Figure 1 and note action of wedge 23 on member 13	1 and 3
x	US 4265595	(GENERAL) see Figures 1 and 4 and column 5 lines 32 et seq	1,3,5 and 7
x	US 4208170	(GENERAL) eg see Figure 4 to 6 and column 5 line 68 to column 6 line 8	1 & 2

Category	Identity of document and relevant passages	Relevant to claim(s
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Categories of documents

- X: Document indicating lack of novelty or of inventive step.
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